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## DESCRIPTION

### ADHESIVE LABEL

#### TECHNICAL FIELD

The present invention relates to an adhesive label, more particularly to a contactless data carrier adhesive label. The present invention may be advantageously applied to a contactless data carrier or a radio frequency identification card in the form of an adhesive label.

#### BACKGROUND ART

A contactless data carrier system includes a data carrier (a transponder) and an interrogator, and a data transmission is made without contact therebetween. The contactless data carrier system, in the form of an adhesive label, is applied, for example, to management of articles to be distributed, by sticking an adhesive label-type data carrier or transponder on a surface of an article, such as personal baggage, to be distributed, or the management of FA (Factory Automation) by sticking an adhesive label-type data carrier or transponder on a surface of a machine component in an assembly-line operation.

As shown in Fig. 3, a typical conventionally used adhesive label-type data carrier has a structure such that a contactless data carrier element mounted on a surface of a circuit substrate 1 is sealed with a resin layer 3, and a surface layer 4 is laminated on the resin layer 3. The contactless data carrier element contains, for example, an electric circuit 21 and electronic components 2 such as an IC chip, a capacitor, a battery and so on. In general, an entire contactless data carrier element is formed on one

side of the circuit substrate 1, as shown in Fig. 3.

Alternatively, the contactless data carrier element may be prepared by separately forming a part of an electric circuit on each side of the circuit substrate 1, and connecting one to the other via a through-hole, to thus integrate the separately formed parts into a sole contactless data carrier element.

Further, as shown in Fig. 3, an adhesive layer 5 is provided on a reverse side of the circuit substrate 1 of the adhesive label-type data carrier. The adhesive label-type data carrier is temporarily applied on a release sheet (not shown). When employed, the adhesive label-type data carrier is peeled therefrom, and applied to a surface of an article 6. In such an adhesive label, a mark for identification and so on is generally printed on a label surface 4a, i.e., a surface 4a of the surface layer 4.

The electronic components forming the contactless data carrier element are thicker than the electric circuit, and thus, an irregular or uneven structure is formed on one surface of the circuit substrate 1. Therefore, this poses a disadvantageous problem in that the irregular or uneven structure affects the surface 4a of the surface layer 4, and a mottle of printing, such as a pin hole occurs.

#### DISCLOSURE OF INVENTION

Accordingly, the object of the present invention is to provide an adhesive label-type contactless data carrier wherein the irregular or uneven structure formed due to the presence of electronic components on a flat circuit substrate of the contactless data carrier element is not reflected on the label surface; a thinning of the structure can be realized; and an excellent printability obtained.

The above object can be achieved by an adhesive label according to the present invention, characterized by comprising a circuit substrate, electronic components formed on one surface of the circuit substrate, and an adhesive layer on the electronic components to be applied to an article, which are sequentially laminated.

In a preferable embodiment of the present invention, the adhesive layer is a pressure sensitive adhesive layer.

In another preferable embodiment of the present invention, a surface layer is provided on a circuit substrate surface that is a reverse side to a surface carrying the electronic components.

#### BRIEF DESCRIPTION OF DRAWINGS

Figure 1 is a sectional view schematically illustrating a state wherein an adhesive label as an embodiment of the present invention is applied to a surface of an article.

Figure 2 is a sectional view schematically illustrating a state wherein an adhesive label as another embodiment of the present invention is applied to a surface of an article.

Figure 3 is a sectional view schematically illustrating a state where a conventional adhesive label is applied to a surface of an article.

#### BEST MODE FOR CARRYING OUT THE INVENTION

Particular embodiments of the present invention will be described hereinafter, with reference to the accompanying drawings.

Fig. 1 is a sectional view schematically illustrating a state wherein an adhesive label 10 as an embodiment of the present invention is applied to a surface of an article 6. One of main purposes of the sectional views including Fig. 1

attached to the present specification is to illustrate structures of the adhesive label. Therefore, the thickness of each layer illustrated is exaggerated, and the ratios of the layers are not precise.

The adhesive label 10 of the present invention is composed of the circuit substrate 1; the contactless data carrier element containing an electric circuit 21 and an IC chip 2, and formed on one surface 1a; and the adhesive layer 7 covering and containing the contactless data carrier element. The adhesive label 10 is stuck to and held on a surface of an article 6 by the adhesive layer 7, and thus the other surface 1b of the circuit substrate 1 becomes a label surface 10b. The label surface 10b of the adhesive label 10 of the present invention is sufficiently flat that, when stuck on a release sheet (not shown) or the article 6 via the adhesive layer 7, it can be printed without any mottle of printing.

Further, the adhesive label 10 of the present invention as shown in Fig. 1 can be made thinner in comparison with the conventional adhesive label-type data carrier. More particularly, the conventional adhesive label-type data carrier as shown in Fig. 3 has a 4-layered structure composed of the surface layer 4, the resin layer 3 covering and sealing the contactless data carrier element containing the electric circuit 21 and IC chip 2, the circuit substrate 1, and the pressure sensitive adhesive layer 5. Whereas the adhesive label 10 of the present invention as shown in Fig. 1 has a 2-layered structure composed of the circuit substrate 1, and the adhesive layer 7 covering and containing the contactless data carrier element containing the electric circuit 21 and IC chip 2. Therefore, a thickness of the adhesive label 10 of the present invention

can be thinned as a whole, the number of the materials used can be reduced, the manufacturing process can be simplified, and the manufacturing cost can be reduced.

As shown in Fig. 2, a surface layer can be added onto the circuit substrate 1, when the circuit substrate 1 of the adhesive label 10 of the present invention as shown in Fig. 1 is transparent or translucent, and thus the contactless data carrier element can be unfavorably seen through the circuit substrate 1 from the label surface 10b, when the material of the circuit substrate 1 has an insufficient printability, or when a part of the electric circuit is formed on a reverse surface to the surface carrying the electronic components such as the IC chip 2. The surface layer can provide a concealing effect or printability.

Fig. 2 is a sectional view schematically illustrating a state where the adhesive label 10 as the embodiment of the present invention having the surface layer is stuck on a surface of the article 6. The adhesive label 10 as shown in Fig. 2 comprises the circuit substrate 1, the contactless data carrier element containing the electric circuit 21 and IC chip 2 and formed on one surface 1a of the circuit substrate 1, the adhesive layer 7 covering and containing the contactless data carrier element, and the surface layer 4 formed on another surface of the circuit substrate 1. In the surface layer 4, the surface 4b that does not come into contact with the circuit substrate 1 becomes the label surface 10b of the adhesive label 10. The label surface 10b of the adhesive label 10 of the present invention is sufficiently flat when stuck on a release sheet (not shown) or the article 6 via the adhesive layer 7, and therefore, can be printed without any mottle of printing. Further, a concealing effect can be obtained when an opaque material is

used as the surface layer 4.

In the adhesive label 10 having the surface layer according to the present invention, as shown in Fig. 2, a part of the electric circuit may be formed on each surface of the circuit substrate 1 and connected one to the other via a through-hole, to thus integrate the separately formed parts in to a contactless data carrier element. It is preferable to form a thinner electric circuit on the side of the surface layer. A thin electric circuit can be formed, for example, by printing the surface with a silver paste, or sputtering.

The circuit substrate which may be used in the present invention is not particularly limited, so long as it will function as a support capable of stably carrying an entire contactless data carrier element or at least a part of the electronic components and the electric circuit of an entire contactless data carrier element on one surface, and maintaining a flatness, and at the same time stably carrying a part of the thin electric circuit on the other surface. The circuit substrate may be transparent, translucent, or opaque.

Specifically, the circuit substrate may be, for example, a paper, a sheet of a natural or synthetic fibrous material, such as a woven fabric sheet, a knitted fabric sheet or a non-woven fabric sheet, a synthetic resin film or sheet. As the synthetic resin, there may be mentioned, for example, polyethylene, polypropylene, polyvinyl chloride, polystyrene, polyester such as polyethylene terephthalate or polyethylene naphthalate, polybutene, polyacrylate, polymethacrylate, polyvinyl alcohol, polyvinyl butyral, polyimide, polycarbonate, polyamide, ethylene-vinyl acetate copolymer, ethylene acrylate copolymer, polyvinyl acetal, ethyl

cellulose, cellulose triacetate, hydroxypropyl cellulose, or acrylonitrile-butadiene-styrene copolymer, or the like. In many cases, an internal structure of the contactless data carrier should be concealed, from a standpoint of design or security. In such a case, the circuit substrate is preferably opaque. The opaque substrate film used may be a substrate made of an opaque material, such as the above-mentioned paper or fibrous material, or a substrate prepared by opacifying the above-mentioned transparent resin film in accordance with any known conventional opacifying methods. The conventional opacifying methods may be, for example, a method wherein an opacifying agent, such as titanium oxide or calcium carbonate is incorporated to the film, a method wherein the film surface is coated or printed with the opacifying agent together with a binder, a method wherein a foaming agent is used, or a method wherein talc having a poor compatibility with the film or the like is incorporated to the film, and then the film is expanded to form micropores in the film, or the like.

The thickness of the circuit substrate is not particularly limited, but is preferably 25  $\mu\text{m}$  to 200  $\mu\text{m}$ .

The contactless data carrier element formed on the surface of the circuit substrate may be composed of the electronic components and the electric circuit. The electric circuit comprises lead wires and antenna coils. The electronic components include, for example, an IC chip, a battery, a capacitor, a resistor, a coil, a diode, or the like. The contactless data carrier element may be formed on one or both surfaces of the circuit substrate according to any known methods. For example, an IC chip, a battery, or a capacitor may be fixed or connected with an adhesive, a solder or an electrically conductive resin to form the

contactless data carrier element. The electric circuit may be formed on one surface of the circuit substrate by printing the surface with an electrically conductive resin, sputtering a metal, or etching a metal foil that has been applied on a surface of the circuit substrate.

The adhesive layer coating the contactless data carrier element may be formed from any pressure sensitive adhesive or heat sensitive adhesive.

As the pressure sensitive adhesive used in the adhesive layer, there may be mentioned, for example, an adhesive based on natural rubber, synthetic rubber, acrylic resin, polyvinyl ether resin, urethane resin, or silicone resin. The synthetic rubber-based adhesive may be, for example, styrene-butadiene rubber, polyisobutylene rubber, isobutylene-isoprene rubber, isoprene rubber, styrene-isoprene block copolymer, styrene-butadiene block copolymer, styrene-ethylene-butylene block copolymer, or the like. The acrylic resin-based adhesive may be, for example, a homopolymer or copolymer of acrylic acid, methyl acrylate, ethyl acrylate, propyl acrylate, butyl acrylate, 2-ethylhexyl acrylate, ethyl methacrylate, butyl methacrylate, acrylonitrile or the like. The polyvinyl ether resin-based adhesive may be, for example, polyvinyl ether, polyvinyl isobutyl ether or the like. The silicone resin-based adhesive may be, for example, dimethyl polysiloxane.

As the heat sensitive adhesive used in the adhesive layer, there may be mentioned, for example, an adhesive based on polyethylene, ethylene-vinyl acetate resin, polyester resin, or polyimide resin. The pressure sensitive adhesive is preferably used, because of the ease with which it can be stuck to an article.

The adhesive layer can be formed by coating the circuit



substrate carrying the contactless data carrier element with the pressure sensitive adhesives or heat sensitive adhesives according to known methods, for example, by means of a roll coater, a knife coater, a die coater/blade coater, a gravure coater, a screen printing, or the like. The thickness of the adhesive layer is generally 20 to 150  $\mu\text{m}$ .

The adhesive layer may be a double-coated adhesive layer having an adhesive layer on each surface of a support sheet. The support sheet may be a material the same as those mentioned for the circuit substrate. The thickness of the support sheet is not particularly limited, but is generally 5 to 30  $\mu\text{m}$ . The adhesive layers formed on both surfaces of the support sheet have a thickness of, preferably 20 to 150  $\mu\text{m}$ , on the circuit substrate side, and a thickness of, preferably 20 to 100  $\mu\text{m}$ , on the article side.

It is preferable to protect the surface of the adhesive layer from pollution with a release sheet. The release sheet is not particularly limited, but for example, is a film of polyethylene terephthalate, polybutylene terephthalate, polyethylene, or polypropylene, polyarylate, or the like, a paper, such as polyethylene laminated paper, polypropylene laminated paper, clay coated paper, resin coated paper, glassine paper, or the like, or the above-mentioned film or paper to which a releasing treatment is applied, if necessary, on a surface to be brought into contact with the adhesive layer.

A typical releasing treatment is, for example, a coating or preparing a releasing agent, such as a releasing agent based on a silicone resin, long-chain alkyl resin, or fluoro-resin. The thickness of the release sheet is not particularly limited, but may be suitably determined.

As in the embodiment shown in Fig. 2, the surface layer

4 may be formed on an outer surface (or the surface side) of the circuit substrate 1 of the adhesive label 10 of the present invention so as to provide it with printability. The surface layer 4 may be a coated paper, a woodfree paper, a synthetic paper, or a film having printability. The surface layer 4 may be stuck to the circuit substrate 1 with an adhesive. The adhesive may be the one mentioned for the adhesive layer 4, a cold setting adhesive, a thermosetting adhesive, or an ultraviolet curing adhesive.

In the data carrier adhesive label of the present invention, the surface layer is preferably opaque to prevent the data carrier element from being seen from the surface, and enhance printability. An opaque paper or film may be used as the surface layer, or a pigment or filler may be dispersed in the adhesive.

The thickness of the adhesive layer for sticking the surface layer is not particularly limited, but is preferably 10 to 100  $\mu\text{m}$ .

The thickness of the surface layer is not particularly limited, but is preferably 25 to 200  $\mu\text{m}$ .

#### EXAMPLE

The present invention will now be further illustrated by, but is by no means limited to, the following Examples.

##### Example 1

On a foamed polyester film (manufactured by Toyobo Co., Ltd.; Crisper-G4712; thickness = 100  $\mu\text{m}$ ) used as the circuit substrate, an electric circuit and an antenna (thickness=10  $\mu\text{m}$ ) were formed in accordance with a screen printing method, using a silver paste (manufactured by Toyobo Co., Ltd.; Electrically conductive paste DW-250). An IC chip (2.8mm x 2.2mm; thickness = 170  $\mu\text{m}$ ) was connected with the electric

circuit by a flip chip bonding to form a contactless data carrier element on the circuit substrate.

A layer (thickness =  $30\mu\text{m}$ ) of an acrylic pressure sensitive adhesive (manufactured by LINTEC Corporation; PA-T1) was formed on a release sheet prepared by coating a glassine paper with a silicone resin. The adhesive layer was superposed onto the surface carrying the contactless data carrier element on the circuit substrate to obtain an adhesive label of the present invention. The adhesive label was used to evaluate printability. The results are shown in Table 1.

#### Example 2

The procedure described in Example 1 was repeated except that a transparent polyester film (thickness =  $100\mu\text{m}$ ) was used as the circuit substrate, to obtain a contactless data carrier adhesive label. Thereafter, a foamed polyester film (manufactured by Toyobo Co., Ltd.; Crisper-G4712; thickness =  $50\mu\text{m}$ ) having a layer (thickness =  $20\mu\text{m}$ ) of an acrylic pressure sensitive adhesive (manufactured by LINTEC Corporation; PA-T1) was stuck to the circuit substrate on a surface which is reverse to the surface carrying the pressure sensitive adhesive to obtain an adhesive label of the present invention. The adhesive label was used to evaluate printability. The results are shown in Table 1.

#### Example 3

A copper foil (thickness =  $35\mu\text{m}$ ) was adhered on a polyimide film (thickness= $75\mu\text{m}$ ; as the circuit substrate), and an electric circuit and an antenna were formed thereon by etching. An IC chip used in Example 1 was connected with the electric circuit by the flip chip bonding as in Example 1 to form a contactless data carrier element on the circuit

substrate.

A double-coated tape carrying a pressure sensitive adhesive (manufactured by LINTEC Corporation; PA-T1) having a thickness of  $20\mu\text{m}$  on one side of a polyester film (thickness =  $25\mu\text{m}$ ), and a pressure sensitive adhesive (manufactured by LINTEC Corporation; PA-T1) having a thickness of  $30\mu\text{m}$  on the other side thereof was prepared. Then, a release sheet prepared by coating a glassine paper with a silicone resin was stuck to the double-coated tape on the pressure sensitive adhesive layer having a thickness of  $20\mu\text{m}$ . The circuit substrate was stuck, at the surface carrying the contactless data carrier element, to the double-coated tape on the pressure sensitive adhesive layer having a thickness of  $30\mu\text{m}$ .

A layer (thickness =  $20\mu\text{m}$ ) of a colored pressure sensitive adhesive [mixture of 2 parts by weight of carbon black (black pigment) and 98 parts by weight of acrylic pressure sensitive adhesive (manufactured by LINTEC Corporation; PA-T1)] was formed on a foamed polyester film (manufactured by Toyobo Co., Ltd.; Crisper-G4712; thickness =  $50\mu\text{m}$ ) by coating, and the resulting film was stuck as a surface layer to the circuit substance on a surface reverse to the surface carrying the contactless data carrier element to obtain an adhesive label of the present invention. The adhesive label was used to evaluate printability. The results are shown in Table 1. The surface layer of the adhesive label prepared in this Example was opaque, and thus the contactless data carrier element was concealed.

#### Comparative Example

On a foamed polyester film (manufactured by Toyobo Co., Ltd.; Crisper-G4712; thickness =  $100\mu\text{m}$ ) used as the circuit substrate, an electric circuit and an antenna (thickness =

10  $\mu\text{m}$ ) were formed in accordance with a screen printing method, using a silver paste (manufactured by Toyobo Co., Ltd.; Electrically conductive paste DW-250). An IC chip (2.8mm x 2.2mm; thickness = 170  $\mu\text{m}$ ) was connected with the electric circuit by a flip chip bonding to form a contactless data carrier element on the circuit substrate.

A layer (thickness = 30  $\mu\text{m}$ ) of an acrylic pressure sensitive adhesive (manufactured by LINTEC Corporation; PA-T1) was formed on a release sheet prepared by coating a glassine paper with a silicone resin. The adhesive layer was stuck to the circuit substrate on a surface reverse to the surface carrying the contactless data carrier element.

Then, a foamed polyester film (manufactured by Toyobo Co., Ltd.; Crisper-G4712; thickness = 50  $\mu\text{m}$ ) carrying a layer (thickness = 20  $\mu\text{m}$ ) of an acrylic pressure sensitive adhesive (manufactured by LINTEC Corporation; PA-T1) was stuck as a surface layer on a surface carrying the contactless data carrier element on the circuit substrate to obtain a comparative adhesive label. The comparative label was used to evaluate printability. The results are shown in Table 1.

#### Evaluation of printability

The adhesive label was printed on a surface reverse to the surface carrying the adhesive layer, by a heat transfer printer (manufactured by Zebra Co., Ltd.; 140Xi), and the resulting printing was visually evaluated. An ink ribbon used was B110CX (manufactured by Ricoh Co. Ltd). The evaluation was made from the standpoint of a defacing of the printing, distorted printing, and pin hole into three ratings as follows:

© ... No defaced printing, no distorted printing, or no pin hole;

○ ... No defaced printing, no distorted printing, but a pin hole partially occurred;

× ... No defaced printing, no distorted printing, but a pin hole occurred.

Table 1

	<u>Printability</u>
Example 1	○
Example 2	○
Example 3	◎
<u>Comparative Example</u>	<u>×</u>

As shown in Table 1, a good printing was obtained without an influence of an irregular or uneven structure due to the electronic components, in the adhesive labels prepared in Examples 1 to 3. In the adhesive label prepared in Comparative Example, however, a resulting printing was influenced by the irregular or uneven structure due to the electronic components, and a pin hole occurred.

#### INDUSTRIAL APPLICABILITY

The present invention can provide an adhesive label that is not influenced by an irregular or uneven structure formed by a contactless data carrier element, even though the present adhesive label is thinner than the conventional adhesive label-type contactless data carrier.

Although the present invention has been described with reference to specific embodiments, various changes and modifications obvious to those skilled in the art are deemed to be within the spirit, scope, and concept of the invention.